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(54) **SWITCH ASSEMBLY FOR ENGAGING A SWITCH OF AN ELECTRONIC DEVICE**

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See application file for complete search history.

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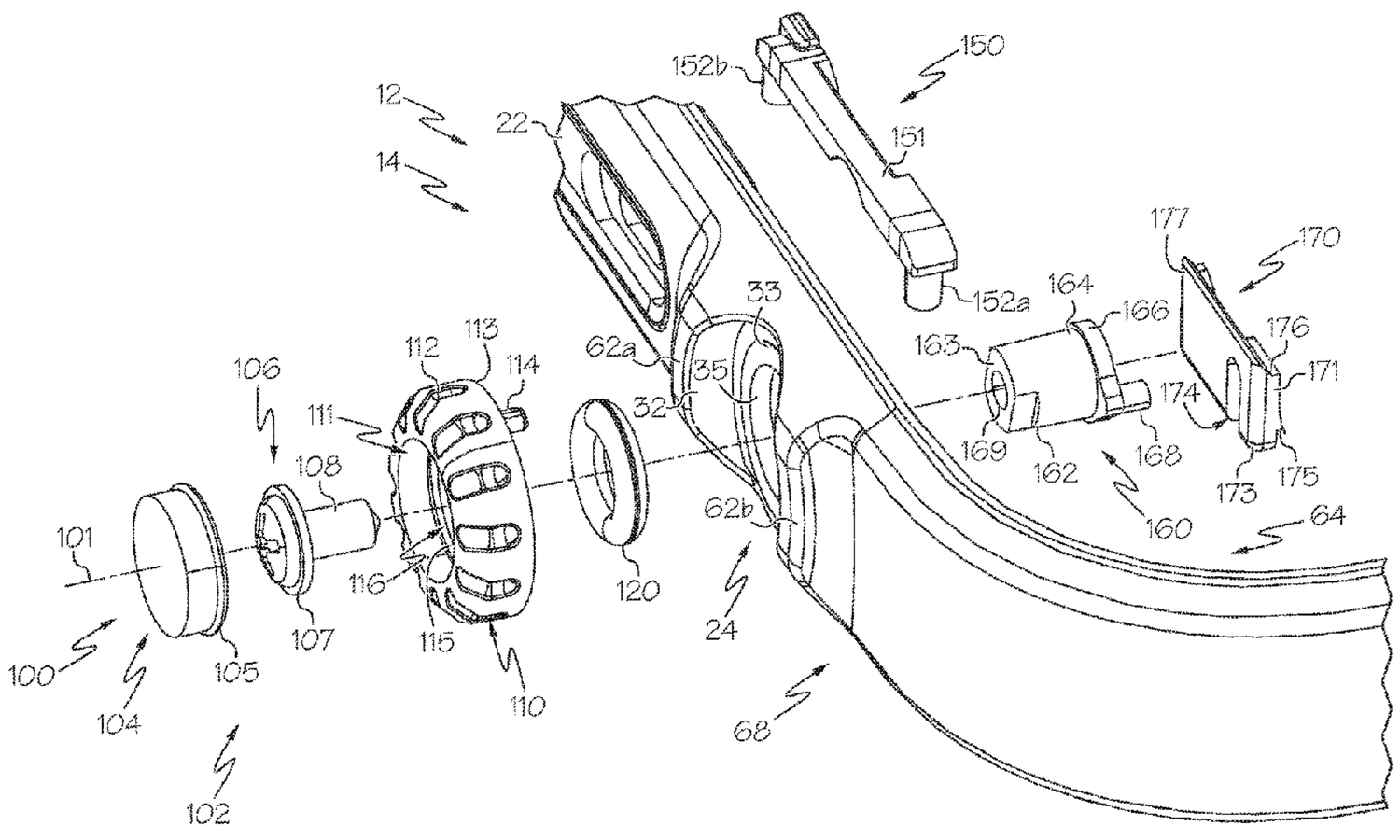
(57) **ABSTRACT**

A switch assembly for engaging a switch of an electronic device includes a rotatable knob having an axis of rotation, a pin mechanism engaged with the rotatable knob, and a slider body. The pin mechanism includes a pin, the pin being offset from the axis of rotation of the rotatable knob. The slider body is shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess shaped to receive and selectively contact the switch of the electronic device. Rotation of the rotatable knob in a first direction causes the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causes the slider body toward contact with a second portion of the switch to urge the switch into a second position.

20 Claims, 8 Drawing Sheets



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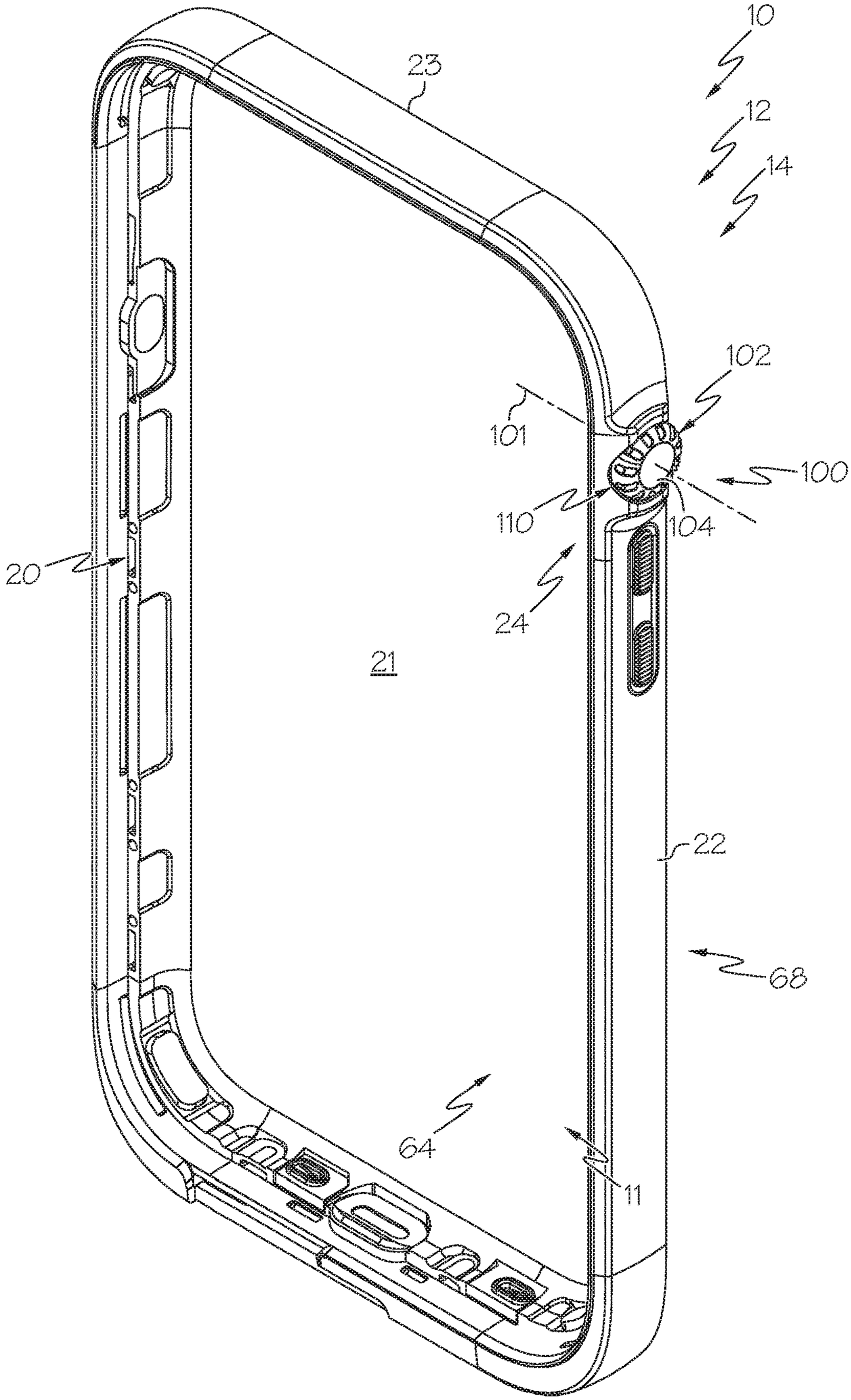

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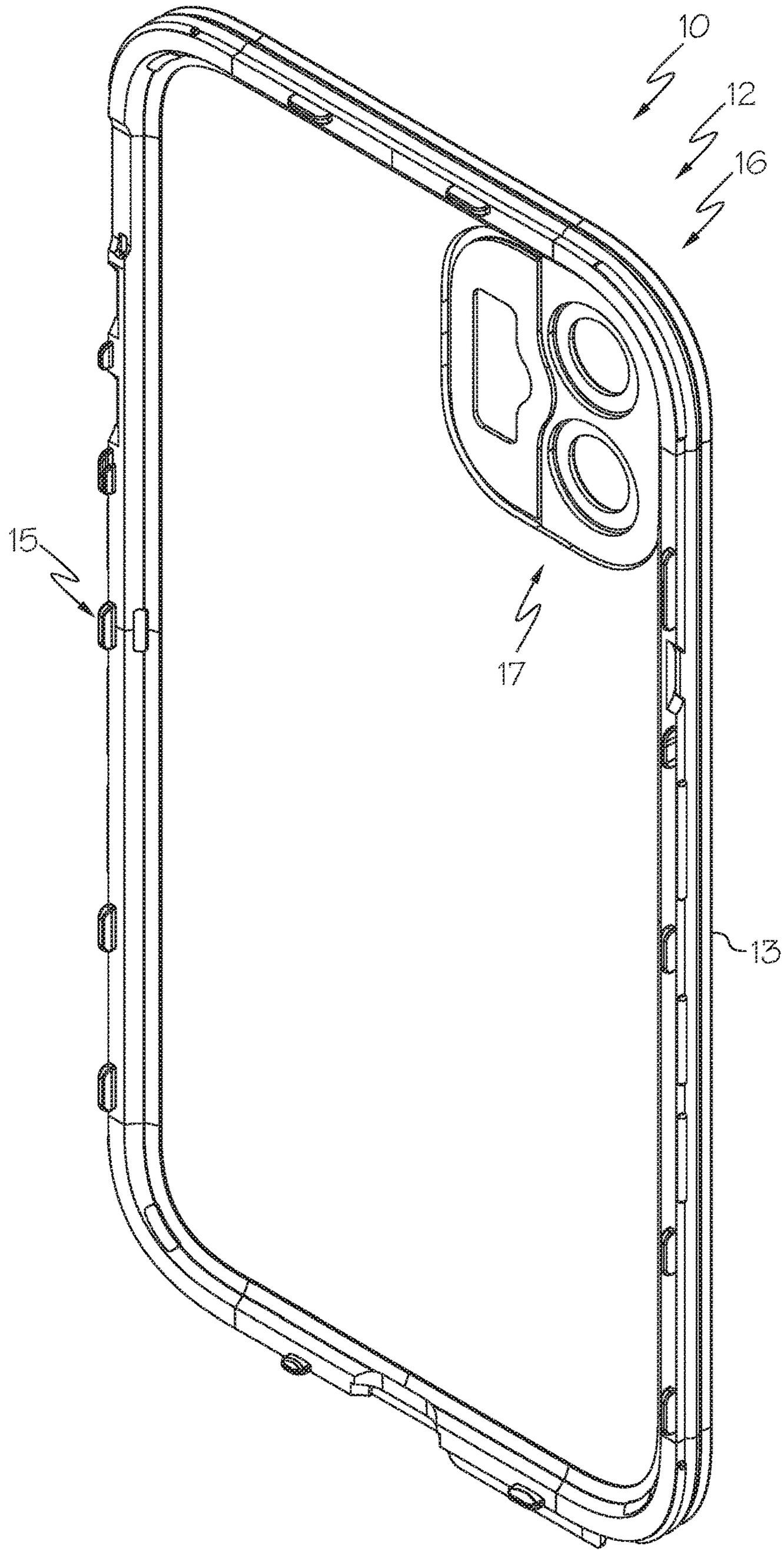

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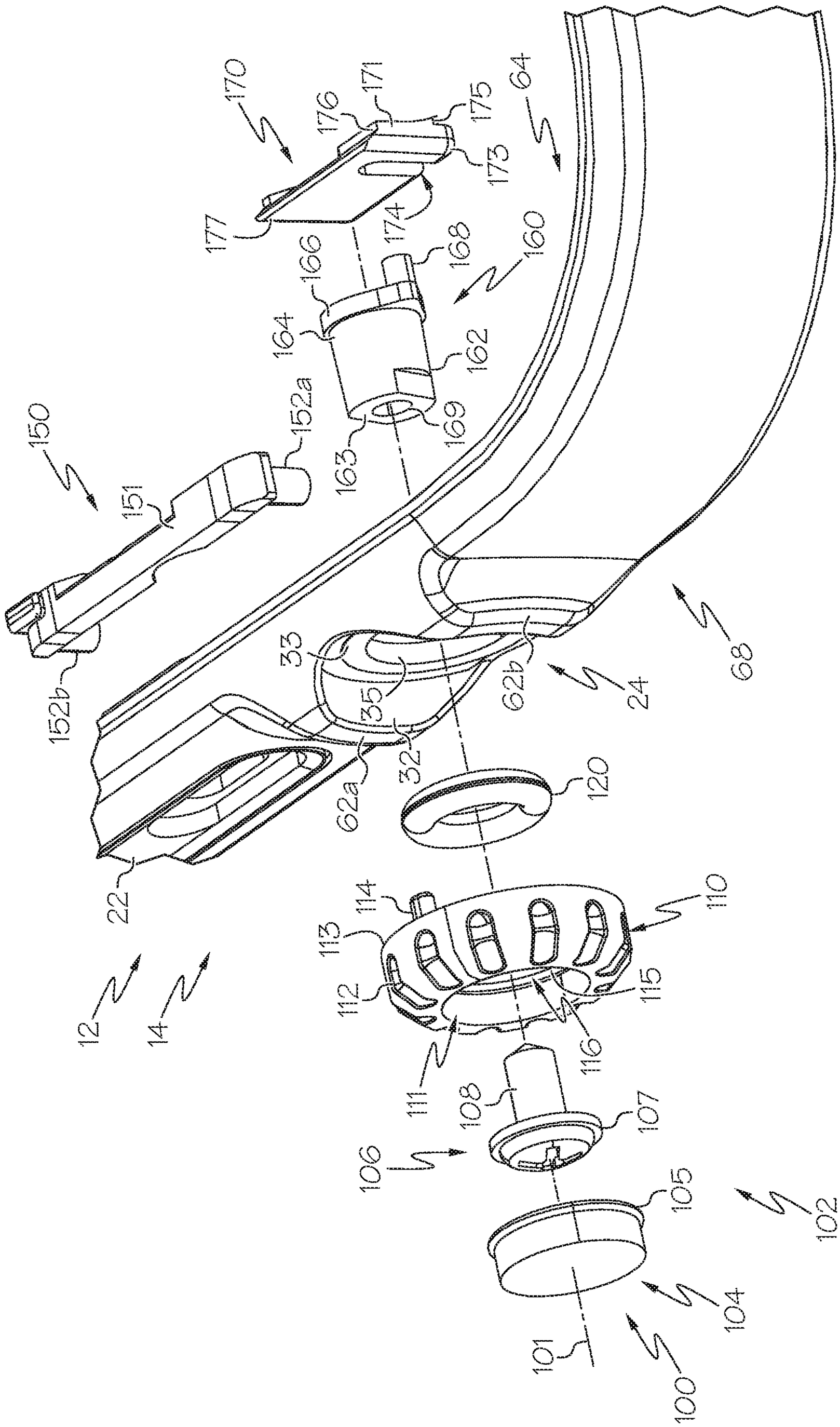
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62b
24
68
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62a
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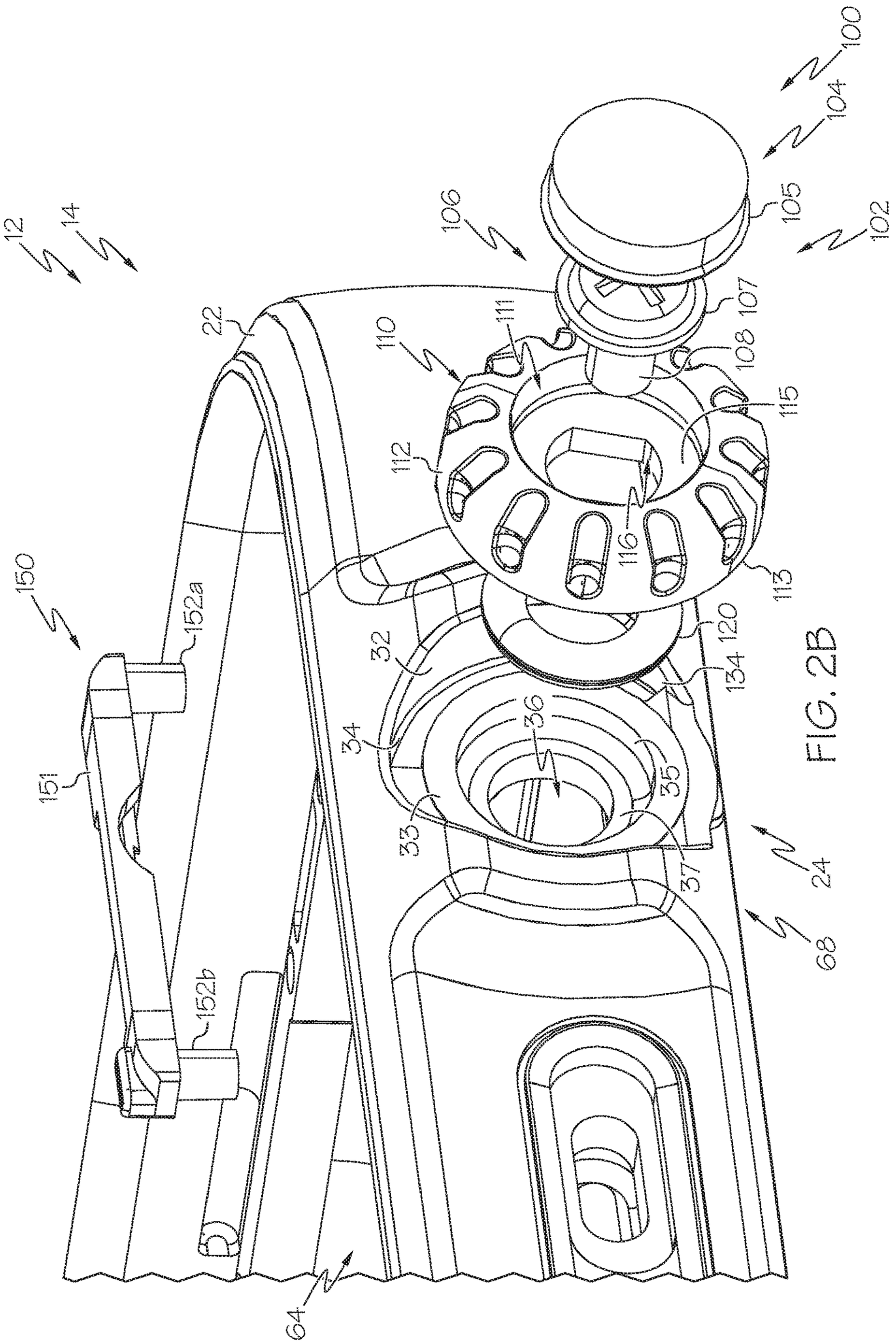
101
100

FIG. 2A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120
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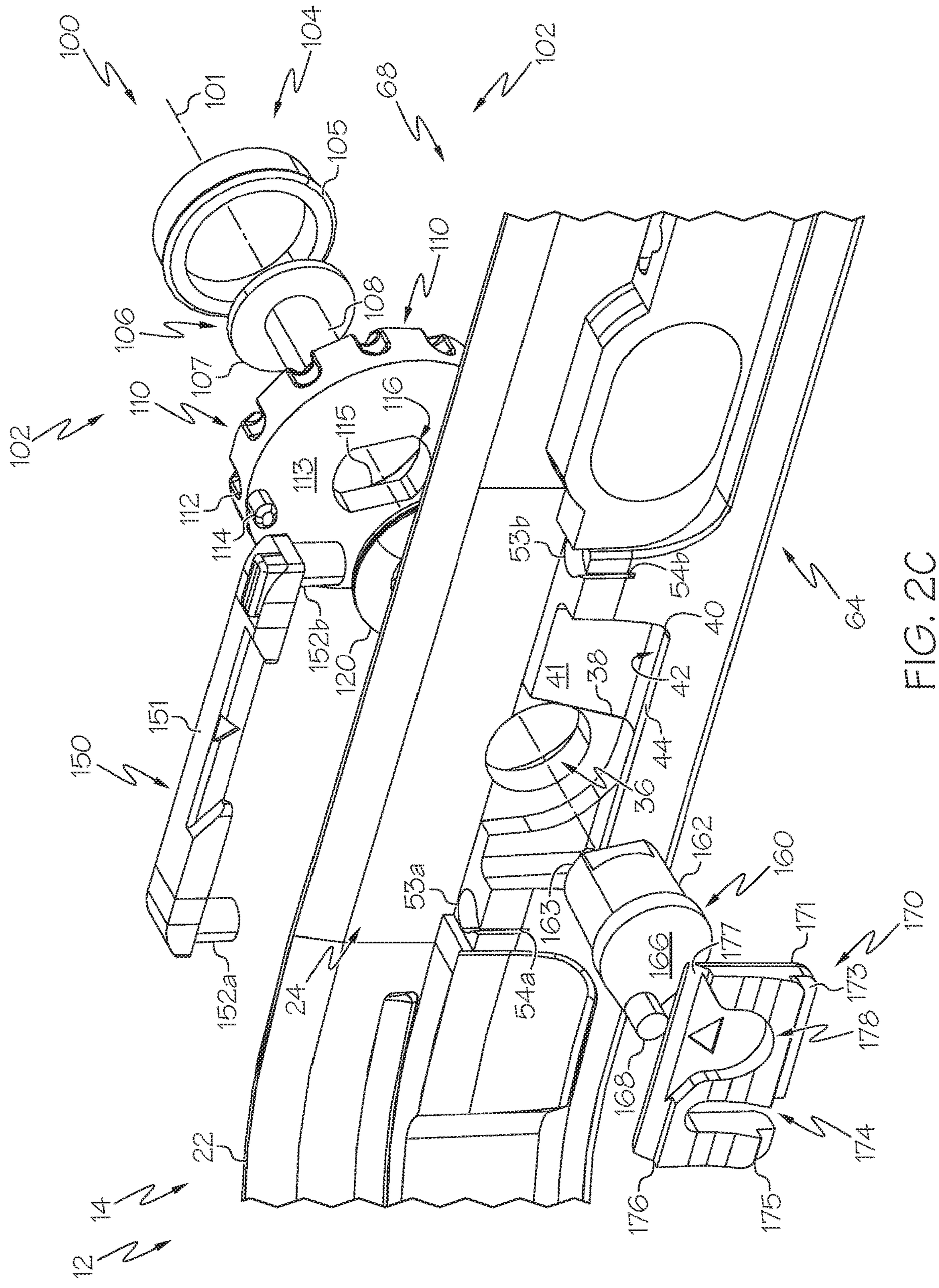
68
64

FIG. 2B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152a
24
53a
54a
163
53b
54b
40
41
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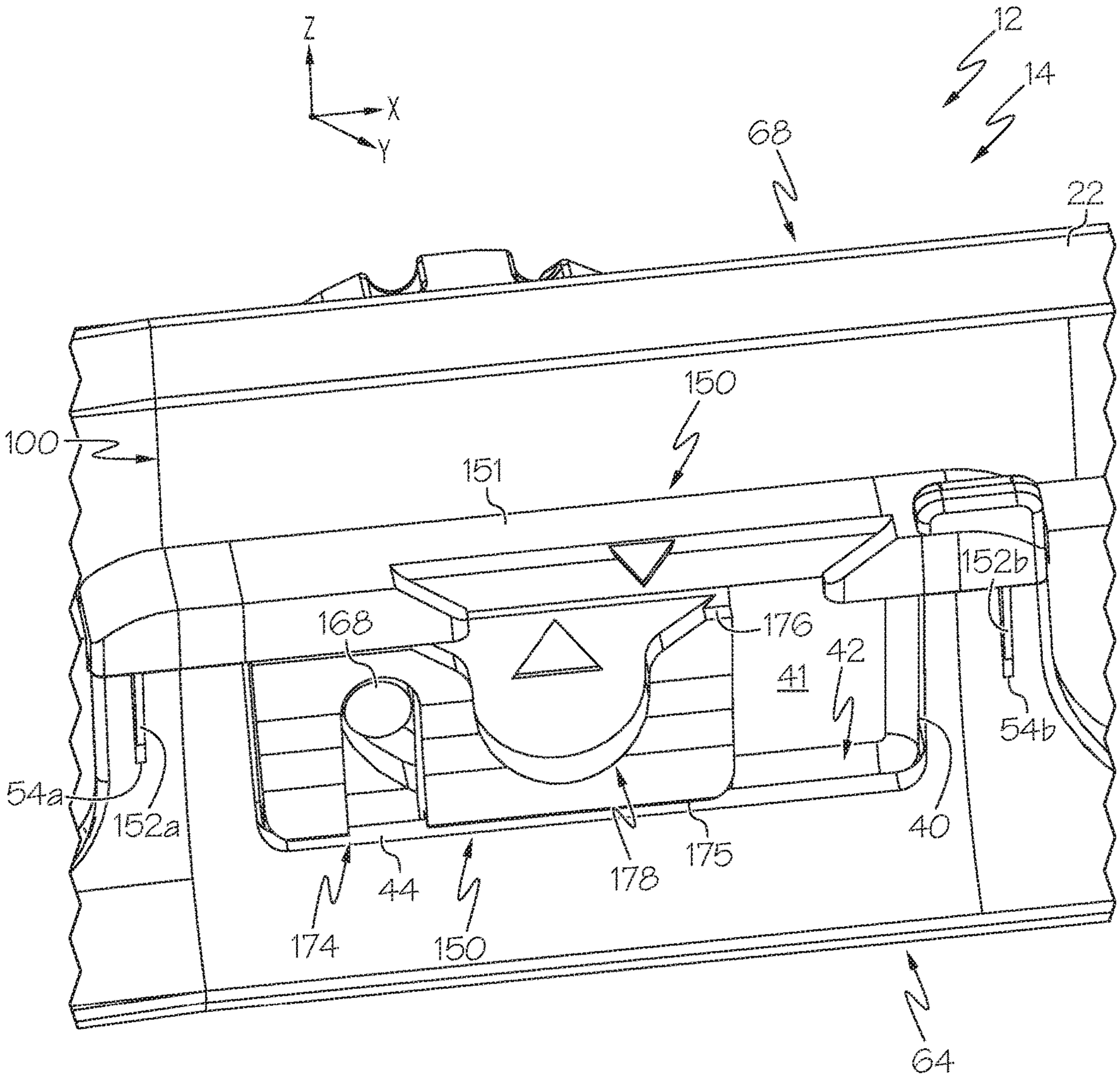
FIG. 2C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174
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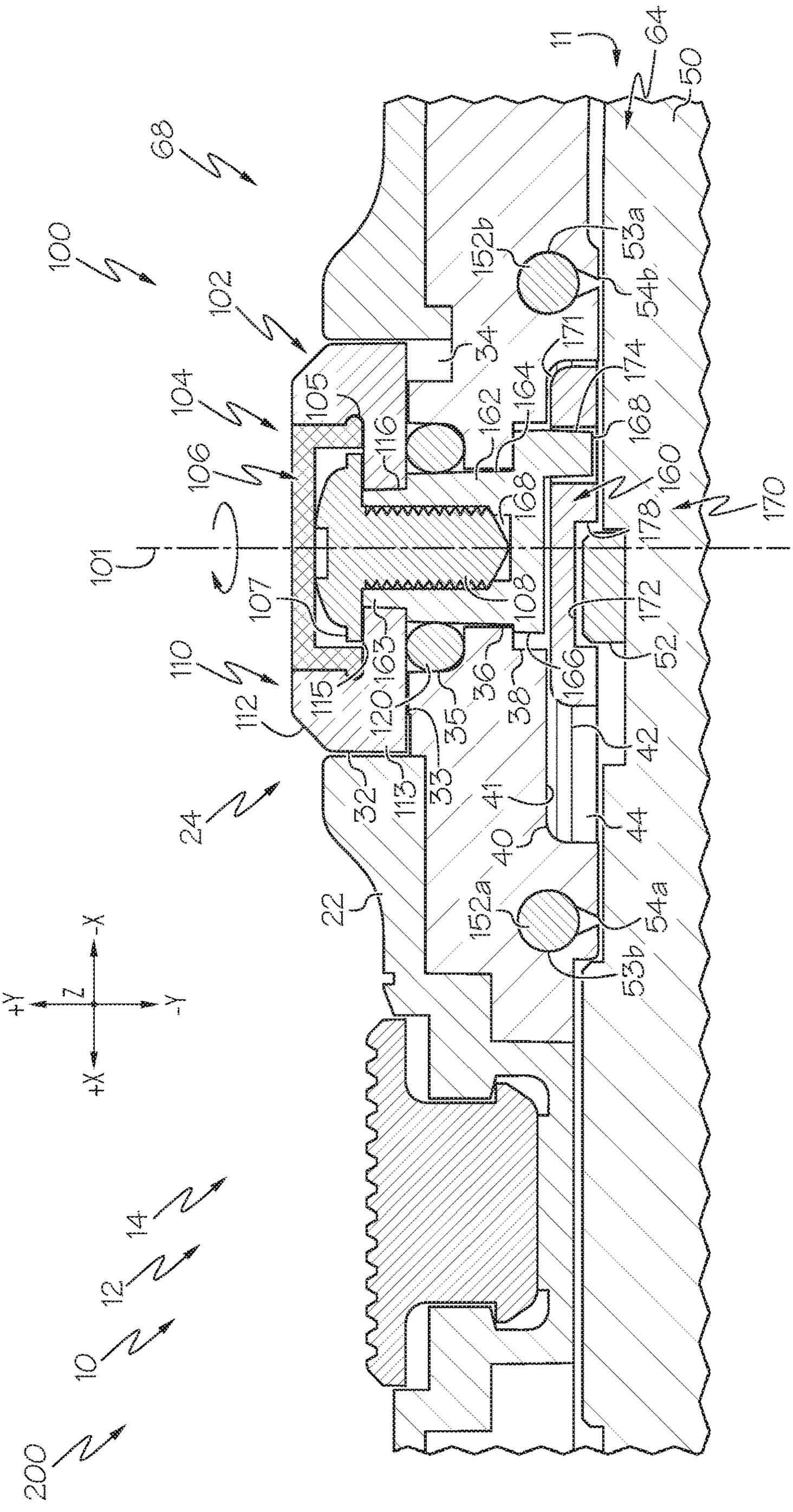
FIG. 3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107
108
172
52
115
120
163
166
36
38
35
32
113
33
41
42
40
44
152a
54a
53b
152b
53a
54b
171
74
34
+Y
-Y
+X
-X
Z
200
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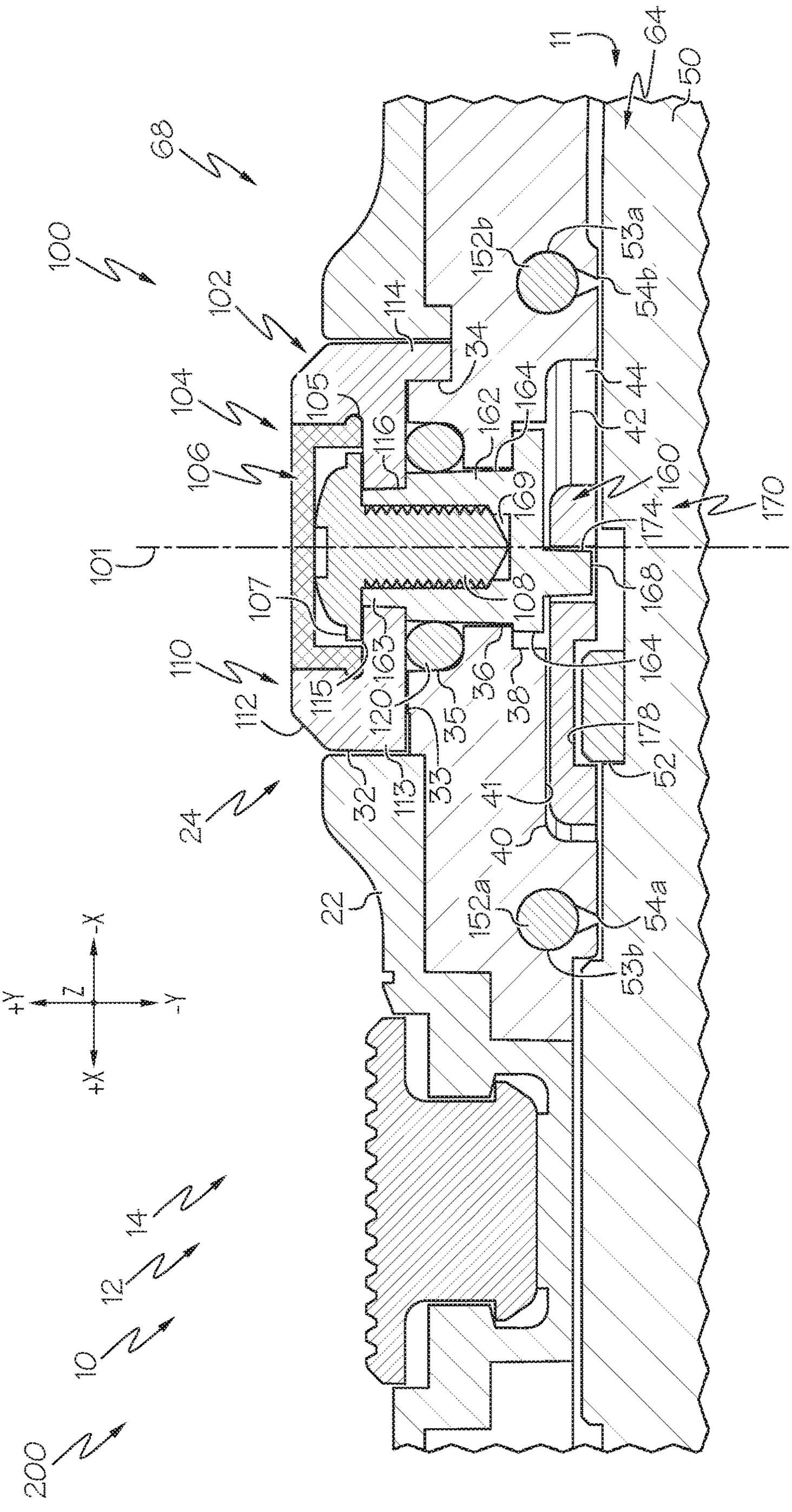
12
14

FIG. 4A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178
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32
113
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41
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152a
54a
53b
+Y
-Y
Z
+X
-X
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14

FIG. 4B

SWITCH ASSEMBLY FOR ENGAGING A SWITCH OF AN ELECTRONIC DEVICE

TECHNICAL FIELD

The present specification generally relates to protective cases that cover electronic devices and, more specifically, cases that have a switch assembly for engaging a switch of an electronic device.

BACKGROUND

As background, electronic devices (e.g., smartphones, tablets, or the like) generally include switches to control various functionality of the device. For example, a switch may include a muting switch that turns off the volume of the mobile device, particularly to silence a ringtone. In order to provide additional protection against falls or fluid contact, protective cases may be arranged around the device while still allowing functional access to the screen and/or buttons of the device. Certain protective cases may include an opening around a switch to allow for direct user access to the sliding switch. However, direct access may inadvertently provide an entry point for fluid into the mobile device, which may lead to water damage. Other protective cases may include a protective switch that covers and engages with the switch of the mobile device such that the protective switch is actuable by a user to move in the same manner as the switch and move the switch. However, direct manipulation of such protective sliding switches may be difficult for some users.

SUMMARY

In one aspect, a switch assembly for engaging a switch of an electronic device includes a rotatable knob having an axis of rotation, a pin mechanism engaged with the rotatable knob, and a slider body. The pin mechanism includes a pin, the pin being offset from the axis of rotation of the rotatable knob. The slider body is shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess. The switch recess is shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body. Rotation of the rotatable knob in a first direction causes the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causes the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position.

In another aspect, a protective case for an electronic device includes a frame shaped to receive the electronic device therein and a switch assembly coupled to the frame for engaging a switch of the electronic device. The switch assembly includes a rotatable knob having an axis of rotation, a pin mechanism engaged with the rotatable knob, and a slider body. The pin mechanism includes a pin, the pin being offset from the axis of rotation of the rotatable knob. The slider body is shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess. The switch recess is shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body. Rotation of the rotatable knob in a first direction causes the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causes the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position.

In yet another aspect, a protective case for an electronic device includes a frame having a front portion and a back portion coupled together to define a cavity shaped to receive and encapsulate the electronic device having a switch, and a switch assembly positioned on one of the front portion or the back portion of the frame for engaging the switch of the electronic device when the electronic device is positioned in the cavity defined by the front portion and the back portion. The switch assembly includes a rotatable knob having an axis of rotation, a pin mechanism engaged with the rotatable knob, and a slider body. The pin mechanism includes a pin, the pin being offset from the axis of rotation of the rotatable knob. The slider body is shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess. The switch recess is shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body. Rotation of the rotatable knob in a first direction causes the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causes the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position.

These and additional features provided by the embodiments described herein will be more fully understood in view of the following detailed description, in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiments set forth in the drawings are illustrative and exemplary in nature and not intended to limit the subject matter defined by the claims. The following detailed description of the illustrative embodiments can be understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

FIG. **1**A depicts a front portion of a protective case, according to one or more embodiments shown and described herein;

FIG. **1**B depicts a back portion of the protective case, according to one or more embodiments shown and described herein;

FIG. **2**A depicts an exploded view of a switch assembly for engaging a sliding switch of a mobile device, according to one or more embodiments shown and described herein;

FIG. **2**B depicts another exploded view of the switch assembly of FIG. **2**A, according to one or more embodiments shown and described herein;

FIG. **2**C depicts another exploded view of the switch assembly of FIG. **2**A, according to one or more embodiments shown and described herein;

FIG. **3** depicts an assembled interior view of the switch assembly of FIGS. **2**A-**2**C, according to one or more embodiments shown and described herein;

FIG. **4**A depicts a cross-sectional view of the switch assembly engaged with a sliding switch of a mobile device in a first position, according to one or more embodiments shown and described herein; and

FIG. **4**B depicts the switch assembly moving the sliding switch of the mobile device to a second position, according to one or more embodiments shown and described herein.

DETAILED DESCRIPTION

The figures generally depict a protective case with an integrated switch assembly for engaging a switch of an electronic device. Switch assemblies according to the present disclosure may include a rotatable knob having an axis of rotation, a pin mechanism, and a slider body. The pin mechanism is engaged with the rotatable knob and includes a pin that is offset from an axis of rotation of the rotatable knob. The slider body may be shaped to include a slot in which the pin of the pin mechanism may be positioned. The slider body may further be shaped to include a switch recess that is shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body. Rotation of the rotatable knob in a first direction may cause the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position (e.g., an active or enabled position). Rotation of the rotatable knob in a second direction may cause the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position (e.g., a deactivated or disabled position). Such switch assembly allows for a switch of an electronic device to be completely enclosed, to prevent ingress of fluid and/or debris, without limiting operation of the switch. Additionally, the present devices provides an easier and more comfortable way to engage the switch of the electronic device. Various embodiments of the switch assembly and protective case will be described in more detail herein.

An electronic device may include any electronic device such as a pager, PDA, cellphone, smart phone, tablet, laptop, or the like. Electronic devices according to the present disclosure may include a switch (e.g., a sliding switch, such as a muting switch). It is noted that a switch may be a switch that slides or toggles from a first position to a second position. As will be described herein, an electronic device may be positioned within the protective case. The protective case may provide a protective, and/or waterproof housing around the mobile the device.

Referring now to FIGS. **1**A and **1**B, an embodiment of a protective case **10** is generally depicted. The protective case **10** generally includes a frame **12**. The frame **12** defines a cavity **11** within which an electronic device may be disposed. The frame **12** may be separable into one or more components to allow for insertion of the electronic device into the cavity **11** defined by the frame **12**. For example, the frame **12** may include a front portion **14**, illustrated in FIG. **1**A and a back portion **16**, illustrated in FIG. **1**B. It is noted that each of the front portion **14** and the back portion **16** may be single integral articles or may be assemblies of sub-frame components.

The front portion **14** and the back portion **16** may be separably coupled to one another. That is, the front portion **14** may be assembled to and disassembled from the back portion **16** repeatedly (e.g., to allow for insertion and removal of the electronic device). When the front portion **14** is assembled to the back portion **16** around an electronic device, a fluid tight seal (e.g., a watertight seal and/or an airtight seal) may be formed between the front portion **14** and the back portion **16** to prevent ingress or egress of liquid, dirt, or other debris, into the protective case **10**, thereby protecting the electronic device from contact with liquid, dirt, or debris. That is, the protective case **10**, when assembled, may provide a waterproof housing for the electronic device positioned therein.

The back portion **16** of the frame **12** may have a body **13** that is arranged to correspond to one or more features of a backside of an electronic device when the electronic device is received within the cavity **11** of the protective case **10**. For example, the back portion **16** of the frame **12** may include one or more camera windows **17** or apertures that are aligned with one or more components of a camera device (e.g., a lens and/or flash) to allow for the capture of images by the electronic device when the electronic device is positioned within the protective case **10**. In addition, the back portion **16** of the frame **12** may be shaped and sized to generally correspond to the shape and size of a particular electronic device such that the electronic device, when received in the protective case **10** fits within the cavity **11** defined by the frame **12**.

The back portion **16** may include one or more projections **15** extending from the body **13** of the back portion **16**. The one or more projections **15** are receivable by one or more receiving apertures **20** in the front portion **14** to couple the front portion **14** to the back portion **16**, the one or more receiving apertures **20** corresponding in shape and size to the one or more projections **15** such that the one or more receiving apertures **20** retain the one or more projections **15** when the back portion **16** is joined with the front portion **14**, as described herein. For example, the back portion **16** may include a plurality of projections disposed around a perimeter of the back portion **16** of the case. In other embodiments, the one or more projections **15** may be part of the front portion **14** of the frame **12** and the one or more receiving apertures **20** may be formed in the back portion **16** of the frame **12**.

The front portion **14** of the frame **12** may be have a body **23** arranged to correspond to one or more features of a front side of an electronic device when the electronic device is received within the cavity **11** of the protective case **10**. For example, the front portion **14** of the frame **12** may include a screen aperture **21** that is aligned within one or more portions of a touch screen or other user input hardware of the electronic device to allow for interaction of a user with the touch screen or other user input hardware. In some embodiments, the screen aperture **21** may include a protective screen made of plastic, glass, or any other suitable material. In addition, the front portion **14** of the frame **12** may be shaped and sized to generally correspond to the shape and size of a particular electronic device such that the electronic device, when received in the protective case **10** fits within the cavity **11** defined by the frame **12**.

The front portion **14**, the back portion **16**, or a combination thereof may define a sidewall **22** of the frame **12**. The sidewall **22** may be arranged to correspond to a perimeter of the electronic device when the electronic device is positioned within the frame **12**. The sidewall **22** may define an interior side **64** and an exterior side **68**, wherein the electronic device is position on an interior side **64** of the sidewall **22** when positioned within the frame **12**. Formed within the sidewall **22** may be an assembly port **24** (further illustrated in FIGS. **2**A-**4**B) to which a switch assembly **100** may be assembled.

That is, coupled to the frame **12** at an assembly port **24** is a switch assembly **100** for engaging a switch **52** of an electronic device **50**, as illustrated in FIGS. **4**A and **4**B. The switch assembly **100** encloses around the switch **52** of the electronic device **50**, and when actuated, allows the switch

assembly **100** to selectively contact the switch **52** to engage and disengage a function of the switch **52** by moving the switch **52** from an active position to an inactive position and vice versa.

FIGS. **2**A-**2**C illustrate various exploded views of the switch assembly **100** from the sidewall **22** of the frame **12**. The various portions of the assembly port **24** will be further described in relation to the various components of the switch assembly **100** mounted to the assembly port **24**. In particular, the switch assembly **100** generally includes a rotatable knob **102**, a pin mechanism **160**, and a slider body **170** mounted to the frame **12** via the assembly port **24**. The assembly port **24** may define one or more recesses for receiving and supporting motion of various components of the switch assembly **100**. These and additional features will be described in greater detail below.

The rotatable knob **102** may include a knob ring **110**, a limit pin **114**, a coupler **106**, and a coupler cover **104**. The rotatable knob **102** has an axis of rotation **101** around which one or more components of the rotatable knob **102** rotates. It is noted that the rotatable knob **102** may include a greater or fewer number of components without departing from the scope of the present disclosure.

The knob ring **110** may be any rotatable or twistable device, which may be rotated or twisted around the axis of rotation **101** of the rotatable knob **102**. For example, the knob ring **110** is illustrated as being approximately circular and defining a coupler-receiving aperture **111**. It is noted that while the knob ring **110** is shown as being circular, other shapes are also contemplated and possible (e.g., oval, egg-shaped, square, rectangular, etc.). The knob ring **110** may define a user engagement surface **112**. In some embodiments, the user engagement surface **112** of the knob ring **110** may be textured in order to improve a user's ability to grip and twist the knob ring **110**. Coupled to an interior facing surface **113** of the knob ring **110**, opposite the user engagement surface **112**, and offset from the axis of rotation **101**, may be the limit pin **114**. That is, the limit pin **114** extends from the interior facing surface **113** of the knob ring **110** at a location that is not a center of the knob ring **110**, as depicted, for example, in FIG. **2**C.

For mounting of the knob ring **110** to the frame **12**, the assembly port **24** of the frame **12** may include a knob mounting recess **32**, in which the rotatable knob **102** may be inserted. For example, the knob mounting recess **32** may define a main chamber sized and shaped to receive the knob ring **110** and allow rotation of the knob ring **110** within the knob mounting recess **32**. Stated another way, the knob recess **32** is a recess formed in to the sidewall **22** of the frame **12**. The knob recess **32** may be defined by separated raised walls **62***a*, **62***b* that extend from the sidewall **112** formed about the assembly port **24** and contiguous to the assembly port **24**. The knob mounting recess **32** may be limited by a backstop wall **33**, which may act to limit an insertion distance of knob ring **110** therethrough. The backstop wall **33** may be recessed into the sidewall **22**, such that when assembled the knob ring **110** sits at least partially recessed into the sidewall **22**.

Positioned adjacent to the backstop wall **33** may be a rotational limit slot **34** in which the limit pin **114** may be positioned (see also FIGS. **4**A and **4**B). The rotational limit slot **34** may define an arc of less than 360° (e.g., less than or equal to 180°, less than or equal to 90°, or the like) around the axis of rotation **101**. Accordingly, as the knob ring **110** is rotated about the axis of rotation **101** of the rotatable knob **102**, the limit pin **114** traverses the rotational limit slot **34**. Once the limit pin **114** reaches an end of the rotational limit slot **34**, the knob ring **110** is prevented from further rotation in that direction by the limit pin **114**. The knob ring **110** may be rotated in an opposite direction until the limit pin **114** reaches a second end of the rotational limit slot **34**. Stated another way, engagement of the limit pin **114** with the rotational limit slot **34** limits the angular rotation of the rotatable knob **102** about the axis of rotation **101** of the rotatable knob **102**.

As noted above, the knob ring **110** may define a coupler-receiving aperture **111** that extends from the user engagement surface **112** to a stop wall **115**. That is, the stop wall **115** may be inset into the knob ring **110**. The coupler **106** may be any device configured to couple the knob ring **110** to the pin mechanism **160**, as will be described in greater detail herein. For example, the coupler **106** may be a threaded fastener having a head **107** and a threaded shank **108**. When assembled to the knob ring **110**, the stop wall **115** of the coupler-receiving aperture **111** may be configured to engage with the head **107** of the coupler **106** to limit the insertion of the coupler **106** through the coupler-receiving aperture **111**. The stop wall **115** may be of such a depth that the head **107** of the coupler **106** is completely positioned within the coupler-receiving aperture **111**.

Referring to FIGS. **4**A and **4**B, which illustrate a cross-section of the protective case **10** along and parallel to the axis of rotation **101** of the switch assembly **100**, formed within the stop wall **115** of the coupler-receiving aperture **111** may be a pass-through opening **116** to allow for the shank **108** of the coupler **106** to extend therethrough. The pass-through opening **116** may have a width larger than a width of the shank **108** to allow for both passage of the shank **108** and, insertion of a portion of a stem **162** of the pin mechanism **160**. In particular, the pass-through opening **116** may be shaped to interlock with a stem **162** of the pin mechanism **160** such that rotation of the rotatable knob **102** causes rotation of the pin mechanism **160**.

The coupler cover **104** may be any device for covering the head **107** of the coupler **106**. For example, the coupler cover **104** may be a cap that may be pressed over the head **107** of the coupler **106** to cover or otherwise camouflage the head **107** of the coupler **106**. The coupler cover **104** may include a locking flange **105** that interlocks with the knob ring **110**, such as illustrated in FIGS. **4**A and **4**B. In particular, FIGS. **4**A and **4**B illustrate the locking flange **105** positioned within a locking recess **103** of the knob ring **110** adjacent to the stop wall **115**. Stated another way, the locking flange **105** is sized and shaped to correspond to the locking recess **103**. When in position within the locking recess **103**, the locking flange **105** may be in contact with the stop wall **115**.

Referring again to FIGS. **2**A and **2**B, the sidewall **22** may further define a sealant recess **35** for receiving an O-ring **120** or other sealant material. For example, inset further inward from the knob mounting recess **32** may be the sealant recess **35**. The sealant recess **35** may have a width less than that of the knob recess **32**. The sealant recess **35** may be sized and shaped for insertion of the O-ring **120** or other sealant material that may aid in preventing ingress of fluid into the protective case **10** through sidewall **22** or switch assembly **100**. The sealant recess **35** may be of a depth such that the O-ring **120** or other sealant material is compressed between the knob ring **110** and a base **37** of the sealant recess **35**. When assembled, the O-ring **120** or other sealant material may be positioned between and in contact with the knob ring **110** and the sidewall **22** (e.g., within the sealant recess **35**) of the frame **12**. The shank **108** of the coupler **106** may extend through a center of the O-ring **120** or other sealant material.

The sidewall **22** may define a through-passage **36** for one or more portions of the switch assembly **100** to extend. For example, the through-passage **36** may extend from the sealant recess **35** through the sidewall **22** to the interior side **68** of the sidewall **22**. As illustrated in FIGS. **4**A and **4**B, when assembled the shank **108** of the coupler **106** may extend at least partially through the through-passage **36** to couple the knob ring **110** to the pin mechanism **160**.

Referring now to FIG. **2**C, the pin mechanism **160** may be any device engagable with the rotatable knob **102** and comprising a pin **168**, which is offset from the axis of rotation **101** of the rotatable knob **102**. For example, the pin **168** is spaced from the axis of rotation **101** and extends outwardly in a direction parallel to the axis of rotation **101**. The pin mechanism **160** may include a stem **162** comprising a first end **163** and a second end **164**, wherein the first end **163** of the stem **162** is engagable with the pass-through opening **116** of the knob ring **110**. In embodiments, the first end **163** of the stem **162** may have a different cross-sectional shape than the second end **164** of the stem **162**. For example, the first end **163** of the stem **162** may be shaped to substantially match a shape of the pass-through opening **116** of the knob ring **110**, such that the first end **163** of the stem **162** may be nested within the pass-through opening **116** of the knob ring **110**. The shape of the first end **163** of the stem **162** and the pass-through opening **116** may prevent rotation of the pin mechanism **160** relative to the knob ring **110**. For example, the first end **163** of the stem **162** may be one or more straight wall sections that correspond to one or more straight wall sections of the pass-through opening **116** and prevent rotation of the first end **163** of the stem **162** within the pass-through opening **116**. Such non-rotatable engagement may fix the pin mechanism **160** relative to the rotatable knob **102** such that rotation of the rotatable knob **102** rotates the pin mechanism **160**.

In some embodiments, the first end **163** of the stem **162** and the second end **164** of the stem **162** may not have different cross-sectional shapes. For example, a non-rotatable engagement may be instead provided through friction (such as provided in a press-fit engagement) that prevents rotation of the pin mechanism **160** relative to the rotatable knob **102**. In yet further embodiment, the action of tightening the coupler **106** may provide enough force to prevent rotation of the pin mechanism **160** relative to the rotatable knob **102**.

A plate **166** may be coupled to the second end **164** of the stem **162** and the pin **168** may be coupled to and extend from the plate **166**. The plate **166** of the pin mechanism **160** may extend past a width of the stem **162** to position the pin **168** further from the axis of rotation **101** of the rotatable knob **102**. In other embodiments, the pin **168** may directly extend from the second end **164** of the stem **162**.

Still referring to FIG. **2**C, an interior side **62** of the sidewall **22** is depicted. Formed in the interior side of the sidewall **22**, the assembly port **24** may further include one or more mounting recesses for mounting the pin mechanism **160** and slider body **170**, described in greater detail below. The through-passage **36** may be sized to a dimension large enough to receive the stem **162** of the pin mechanism **160** therethrough and support rotational motion of the stem **162** about the axis of rotation **101**. The through-passage **36** may open to a plate-receiving groove **38**, which opens further into a slider groove **40**. Stated another way, the plate-receiving groove **38** may be formed or otherwise inset into a back wall **41** of the slider groove **40**.

Referring to FIGS. **4**A and **4**B, the stem **162** of the pin mechanism **160** may be advanced through the through-passage **36**, through a center of the O-ring **120** or other sealant material, until the plate **166** of the pin mechanism **160** is positioned and contacted with the plate-receiving groove **38** to abut the through-passage **36**. The O-ring **120** or other sealant material may form a fluid and/or airtight seal around the stem **162** of the pin mechanism **160**. The first end **163** of the stem **162** may then be inserted into the pass-through opening **116** of the knob ring **110**. The shank **108** of the coupler **106** may be engaged with an opening **169** (e.g., a threaded passage) formed within and extending into the first end **163** of the stem **162**. The coupler **106** can be advanced into the opening **169** of the stem **162** until the head **107** of the coupler **106** engages the stop wall **115** of the knob ring **110**. The coupler cover **104** may then be snapped into place over the head **107** of the coupler **106** to conceal the coupler **106**. When assembled, the pin **168** of the pin mechanism **160** extends from the plate **166** into a volume of the slider groove **40** and into slot **174** of slider body **170**.

The slider body **170** may be slidably disposed in the slider groove **40** and configured to slide along the slide path (e.g., along the X-direction of the coordinate axes depicted in FIGS. **3**, **4**A, and **4**B) defined by the slider groove **40**. The slider body **170** may be shaped to include the slot **174** in which the pin **168** of the pin mechanism **160** is positioned when the switch assembly **100** is assembled. The slot **174** may define a travel path (e.g., along a Z-direction of the coordinate axes depicted in FIGS. **3**, **4**A, and **4**B) through which the pin **168** can travel. As illustrated, the travel path as defined by the slot **174** may be perpendicular to the axis of rotation **101** (e.g., extending along the Y-direction of the coordinate axes depicted in FIGS. **3**, **4**A, and **4**B) of the rotatable knob **102**. Furthermore, the travel path as defined by the slot **174** may be perpendicular to a slide path of the slider body **170** defined by the slider groove **40**. For example, and as illustrated in FIGS. **4**A and **4**B, as the rotatable knob **102** is rotated about the axis of rotation **101**, the pin **168** traverses the slot **174**, which pushes the slider body **170** to slide along the slider groove **40** in a direction perpendicular to the axis of rotation **101** along the rotatable knob **102**.

The slider body **170** may further also be shaped to include a switch recess **178** shaped to receive and selective contact a switch **52** of the electronic device **50** (illustrated in FIGS. **4**A and **4**B). For example, the switch recess **178** may engage the switch **52** such that movement of the slider body **170** causes the switch **52** to move between a first position, shown in FIG. **4**A, and a second position (e.g., a silencing position and a sound-on position where the switch **52** is a silencing switch **52**), shown in FIG. **4**B. For example, the slider body **170** may be moved into contact with a first portion **54** of the switch **52** to urge the switch **52** into a first position (e.g., as shown in FIG. **4**A). The slider body **170** may be moved into contact with a second portion **56** of the switch **52** to urge the switch **52** into a second position (e.g., as shown in FIG. **4**B).

To retain the slider body **170** within the slider groove **40**, the slider body **170** may have one or more locking flanges. For example, the slider body **170** may include a first locking flange **173** coupled to and extending along a first edge **175** of the slider body **170**. The first locking flange **173** may have a reduced thickness relative to a thickness of the first edge **175** of the slider body **170**. The first locking flange **173** may be integral with the slider body **170** or a separate component therefrom. The first locking flange **173** may be continuous along the first edge **175** or may be discontinuous along the first edge **175**. For example and as illustrated, the first locking flange **173** may not be continuous across a base of the slot **174**.

The slider groove **40** may have a channel **42** formed at the base of the slider groove **40**. When assembled, the first locking flange **173** may be inserted into the channel **42** and slidable along the channel **42**. The first edge **175** of the slider body **170** may positioned over and in contact with a base surface **44** of the slider groove **40**.

The slider body **170** may include a second locking flange **177** along a second edge **176** of the slider body **170** opposite the first edge **175**. The second locking flange **177** may have a reduced thickness relative to a thickness of the second edge **176** of the slider body **170**. The second locking flange **177** may be integral with the slider body **170** or a separate component therefrom. The second locking flange **177** may be continuous along the second edge **176** or may be discontinuous along the second edge **176**. In some embodiments, the switch recess **178** may have an inset depth greater than a thickness of the second locking flange **177**.

A locking mechanism **150** may be provided to engage the second locking flange **177** so as to lock the slider body **170** into the slider groove **40**. That is, the locking mechanism **150** may be arranged about the slider body **170** to restrict motion of the slider body **170** in a direction transverse to the slide path as defined by the slider groove **40**. To facilitate locking of the slider body **170** within the slider groove **40**, the locking mechanism **150** may comprise an elongate body **151**. Referring to FIG. **3**, when assembled, the elongate body **151** may extend over the second locking flange **177** to prevent the slider body **170** from becoming dislodged from the slider groove **40**. The elongate body **151** may have a reduced thickness over the switch recess **178**, to allow for insertion of the switch **52** passed the elongate body **151** and into the switch recess **178**.

At either end of the elongate body **151**, may be locking prongs **152***a*, **152***b*, configured to mate with mating apertures **53***a*, **53***b* formed within the frame **12**, illustrated in FIG. **2**C. Stated another way, a first locking prong **152***a* may extend from a first end of the elongate body **151** and a second locking prong **152***b* may extend from a second end of the elongate body **151**. The first mating aperture **53***a* may extend into the frame **12** on one side of the assembly port **24** and the second mating aperture **53***b* may be extend into the frame **12** on a second side of the assembly port **24**. The locking prongs **152***a*, **152***b* may be pressed into the mating apertures **53***a*, **53***b* to mount the locking mechanism **150** to the frame **12**. The locking prongs **152***a*, **152***b* may engage the mating apertures **53***a*, **53***b* in a press fit to ensure a secure engagement between the locking prongs **152***a*, **152***b* and the mating apertures **53***a*, **53***b*. In some embodiments, the mating apertures **53***a*, **53***b* may include pressure release slits **54***a*, **54***b*, to allow for escape of air when mating the locking prongs **152***a*, **152***b* with the mating apertures **53***a*, **53***b*.

Referring now to FIGS. **4**A and **4**B, operation of the switch assembly **100** will now be described. FIG. **4**A illustrates an electronic device **50** positioned within the protective case **10** to provide an electronic device assembly **200**. That is, the protective case **10** provides a protective covering to the electronic device **50**. Referring to FIGS. **1**A and **1**B, the front portion **14** couples to the back portion **16** of the frame **12** to encapsulate the electronic device **50** within the protective case **10** within cavity **11**. The switch **52** of the electronic device **50** is positioned in a first position (e.g., an active position) and at least partially positioned within the switch recess **178** of the slider body **170**. Accordingly, when the slider body **170** moves, the slider body **170** is selectively contacted with the first or second portions **54**, **56** of the switch **52**. The contact between the slider body **170** and the switch **52** causes the switch **52** to move from the first position to the second position shown in FIG. **4**B.

To cause the slider body **170** to move the switch **52** from the first position to the second position, a user may contact the contact surface **112** of the knob ring **110**, and twist the knob ring **110** about the axis of rotation **101** in a first direction (e.g., a clockwise direction). Such twisting causes the pin mechanism **160** to travel the pin **168** within the slot **174** of the slider body **170** in a first direction and move the slider body **170** toward contact with the first portion **54** of the switch **52** to urge the switch **52** to a first position. That is, movement of the pin **168** imparts a force to the slider body **170** surrounding the slot **174**, causing the slider body **170** to move along the slide path and the pin **168** to move along the slot **174**. As the slider body **170** moves, the force is transferred to the switch **52**, which causes the switch **52** to move with the slider body **170** to the second position shown in FIG. **4**B.

To move the switch **52** back to the original position shown in FIG. **4**A, a user may engage the contact surface **112** of the knob ring **110** and twist the knob ring **110** about the axis of rotation **101** in a second direction (e.g., a counterclockwise direction). The opposite twisting direction causes the pin mechanism **160** to traverse the pin **168** along the slot **174** in opposite second, opposite direction to move the slider body **170** toward contact with the second portion **26** of the switch **52** to urge the switch **52** to a second position. That is, the pin **168** applies a force to the slider body **170** to move the slider body **170** and the switch **52** back to the second position depicted in FIG. **4**A.

Embodiments can be described with reference to the following numbered clauses, with preferred features laid out in the dependent clauses.

1. A switch assembly for engaging a switch of an electronic device, the switch assembly comprising: a rotatable knob having an axis of rotation; a pin mechanism engaged with the rotatable knob and comprising a pin, the pin being offset from the axis of rotation of the rotatable knob; and a slider body, the slider body being shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess, the switch recess being shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body, rotation of the rotatable knob in a first direction causing the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causing the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position.

2. The switch assembly of clause 1, wherein the rotatable knob comprises: a knob ring, and a limit pin coupled the knob ring, wherein the limit pin limits an angular rotation of the rotatable knob.

3. The switch assembly of clause 1 or 2, wherein the slot defines a travel path perpendicular to the axis of rotation of the rotatable knob.

4. The switch assembly of any preceding clause, wherein the pin mechanism comprises: a stem comprising a first end and a second end; and a plate coupled to the second end of the stem, wherein the pin is coupled to the plate and extends therefrom and into the slot of the slider body.

5. The switch assembly of clause 4, wherein: the rotatable knob comprises a pass-through opening; and the first end of

the stem is positioned within the pass-through opening of the rotatable knob such that the stem is non-rotatable relative to the rotatable knob.

6. A protective case for an electronic device, the protective case comprising: a frame shaped to receive the electronic device therein; and a switch assembly coupled to the frame for engaging a switch of the electronic device, the switch assembly comprising: a rotatable knob having an axis of rotation; a pin mechanism engaged with the rotatable knob and comprising a pin, the pin being offset from the axis of rotation of the rotatable knob; and a slider body, the slider body being shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess, the switch recess being shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body, rotation of the rotatable knob in a first direction causing the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causing the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position.

7. The protective case of clause 6, wherein: the rotatable knob comprises: a knob ring, and a limit pin coupled the knob ring; and the frame defines a rotational limit slot formed therein, wherein the limit pin is positioned within the rotational limit slot and movement of the pin through the rotational limit slot limits an angular rotation of the rotatable knob.

8. The protective case of clause 6 or 7, wherein the frame defines a slider groove defining a slide path and the slider body is slidably disposed within the slider groove.

9. The protective case of clause 8, further comprising a locking mechanism positioned to restrict motion of the slider body in a direction transverse to the slide path.

10. The protective case of clause 9, wherein the locking mechanism comprises: an elongate body spanning across a portion of the slider body; a first locking prong coupled to a first end of the elongate body and inserted into the frame proximate to a first side of the slider groove; and a second locking prong coupled to a second end of the elongate body and inserted into the frame proximate to a second side of the slider groove.

11. The protective case of any of clauses 6-10, wherein the pin mechanism comprises: a stem comprising a first end and a second end; and a plate coupled to the second end of the stem, wherein the pin is coupled to the plate and extends therefrom and into the slot of the slider body.

12. The protective case of clause 11, wherein the frame further defines a plate-receiving groove formed within a back wall of the slider groove, wherein the plate is engaged with the plate-receiving groove and the stem extends through the frame from a first side of the frame to a second side of the frame, and wherein the first end of the stem is positioned within a pass-through opening of the rotatable knob such that the stem is non-rotatable relative to the rotatable knob.

13. A protective case for an electronic device, the protective case comprising: a frame comprising a front portion and a back portion coupled together to define a cavity shaped to receive and encapsulate the electronic device having a switch; a switch assembly positioned on one of the front portion or the back portion of the frame for engaging the switch of the electronic device when the electronic device is positioned in the cavity defined by the front portion and the back portion, the switch assembly comprising: a rotatable knob having an axis of rotation; a pin mechanism engaged with the rotatable knob and comprising a pin, the pin being offset from the axis of rotation of the rotatable knob; and a slider body, the slider body being shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess, the switch recess being shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body, rotation of the rotatable knob in a first direction causing the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causing the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position.

14. The protective case of clause 13, wherein: the rotatable knob comprises: a knob ring, and a limit pin coupled the knob ring; and the front portion of the frame defines a rotational limit slot formed therein, wherein the limit pin is positioned within the rotational limit slot and movement of the pin through the rotational limit slot limits an angular rotation of the rotatable knob.

15. The protective case of clause 13 or 14, wherein the front portion of the frame defines a slider groove defining a slide path and the slider body is slidably disposed within the slider groove.

16. The protective case of any of clauses 13-15, further comprising a locking mechanism positioned to restrict motion of the slider body in a direction transverse to a slide path of the slider body.

17. The protective case of clause 16, wherein the locking mechanism comprises: an elongate body spanning across a portion of the slider body; a first locking prong coupled to a first end of the elongate body and inserted into the frame proximate to a first side of a slider groove in which the slider body is slidably disposed; and a second locking prong coupled to a second end of the elongate body and inserted into the frame proximate to a second side of the slider groove.

18. The protective case of clause 16, wherein the locking mechanism comprises an elongate body and a first locking prong at a first end of the elongate body and a second locking prong at a second end of the elongate body.

19. The protective case of any of clauses 13-19, wherein the pin mechanism comprises: a stem comprising a first end and a second end; and a plate coupled to the second end of the stem, wherein the pin is coupled to the plate and extends therefrom and into the slot of the slider body.

20. The protective case of clause 19, wherein the front portion of the frame wherein the frame further defines a plate-receiving groove formed within a back wall of the slider groove, wherein the plate is engaged with the plate-receiving groove and the stem extends through the frame from a first side of the frame to a second side of the frame, and wherein the first end of the stem is positioned within a pass-through opening of the rotatable knob such that the stem is non-rotatable relative to the rotatable knob.

It should now be understood that embodiments as provided wherein are directed to switch assemblies that include a rotatable knob having an axis of rotation, a pin mechanism, and a slider body. The pin mechanism is engaged with the rotatable knob and includes a pin that is offset from an axis of rotation of the rotatable knob. The slider body may be shaped to include a slot in which the pin of the pin mechanism may be positioned. The slider body may further

be shaped to include a switch recess that is shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned proximate the slider body. Rotation of the rotatable knob in a first direction may cause the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position (e.g., an active or enabled position). Rotation of the rotatable knob in a second direction may cause the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position (e.g., a deactivated or disabled position). Such switch assembly allows for a switch of an electronic device to be completely enclosed, to prevent ingress of fluid and/or debris, without limiting operation of the switch. Additionally, the present devices provides an easier and more comfortable way to engage the switch of the electronic device.

It is noted that the terms "substantially" and "about" may be utilized herein to represent the inherent degree of uncertainty that may be attributed to any quantitative comparison, value, measurement, or other representation. These terms are also utilized herein to represent the degree by which a quantitative representation may vary from a stated reference without resulting in a change in the basic function of the subject matter at issue.

While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

What is claimed is:

1. A switch assembly for engaging a switch of an electronic device, the switch assembly comprising:

a rotatable knob having an axis of rotation;

a pin mechanism engaged with the rotatable knob and comprising a pin, the pin being offset from the axis of rotation of the rotatable knob; and

a slider body, the slider body being shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess, the switch recess being shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned within a protective case including the switch assembly such that the switch of the electronic device is positioned within the switch recess of the slider body, rotation of the rotatable knob in a first direction causing the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causing the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position, wherein the slider body slides along a length of the protective case.

2. The switch assembly of claim **1**, wherein the rotatable knob comprises:

a knob ring, and

a limit pin coupled the knob ring, wherein the limit pin limits an angular rotation of the rotatable knob.

3. The switch assembly of claim **1**, wherein the slot defines a travel path perpendicular to the axis of rotation of the rotatable knob.

4. The switch assembly of claim **1**, wherein the pin mechanism comprises:

a stem comprising a first end and a second end; and

a plate coupled to the second end of the stem, wherein the pin is coupled to the plate and extends therefrom and into the slot of the slider body.

5. The switch assembly of claim **4**, wherein:

the rotatable knob comprises a pass-through opening; and

the first end of the stem is positioned within the pass-through opening of the rotatable knob such that the stem is non-rotatable relative to the rotatable knob.

6. A protective case for an electronic device, the protective case comprising:

a frame shaped to receive the electronic device therein; and

a switch assembly coupled to the frame for engaging a switch of the electronic device, the switch assembly comprising:

a rotatable knob having an axis of rotation;

a pin mechanism engaged with the rotatable knob and comprising a pin, the pin being offset from the axis of rotation of the rotatable knob; and

a slider body, the slider body being shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess, the switch recess being shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned within the protective case such that the switch of the electronic device is positioned within the switch recess of the slider body, rotation of the rotatable knob in a first direction causing the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causing the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position, wherein the slider body slides along a length of the protective case.

7. The protective case of claim **6**, wherein:

the rotatable knob comprises:

a knob ring, and

a limit pin coupled the knob ring; and

the frame defines a rotational limit slot formed therein, wherein the limit pin is positioned within the rotational limit slot and movement of the pin through the rotational limit slot limits an angular rotation of the rotatable knob.

8. The protective case of claim **6**, wherein the frame defines a slider groove defining a slide path and the slider body is slidably disposed within the slider groove.

9. The protective case of claim **8**, further comprising a locking mechanism positioned to restrict motion of the slider body in a direction transverse to the slide path.

10. The protective case of claim **9**, wherein the locking mechanism comprises:

an elongate body spanning across a portion of the slider body;

a first locking prong coupled to a first end of the elongate body and inserted into the frame proximate to a first side of the slider groove; and

a second locking prong coupled to a second end of the elongate body and inserted into the frame proximate to a second side of the slider groove.

11. The protective case of claim **8**, wherein the pin mechanism comprises:

a stem comprising a first end and a second end; and

a plate coupled to the second end of the stem, wherein the pin is coupled to the plate and extends therefrom and into the slot of the slider body.

12. The protective case of claim **11**, wherein the frame further defines a plate-receiving groove formed within a back wall of the slider groove, wherein the plate is engaged with the plate-receiving groove and the stem extends through the frame from a first side of the frame to a second side of the frame, and wherein the first end of the stem is positioned within a pass-through opening of the rotatable knob such that the stem is non-rotatable relative to the rotatable knob.

13. A protective case for an electronic device, the protective case comprising:

a frame comprising a front portion and a back portion coupled together to define a cavity shaped to receive and encapsulate the electronic device having a switch;

a switch assembly positioned on one of the front portion or the back portion of the frame for engaging the switch of the electronic device when the electronic device is positioned in the cavity defined by the front portion and the back portion, the switch assembly comprising:

a rotatable knob having an axis of rotation;

a pin mechanism engaged with the rotatable knob and comprising a pin, the pin being offset from the axis of rotation of the rotatable knob; and

a slider body, the slider body being shaped to include a slot in which the pin of the pin mechanism is positioned and a switch recess, the switch recess being shaped to receive and selectively contact the switch of the electronic device when the electronic device is positioned within the protective case such that the switch of the electronic device is positioned within the switch recess of the slider body, rotation of the rotatable knob in a first direction causing the pin to travel in the slot in a first direction and move the slider body toward contact with a first portion of the switch to urge the switch into a first position, and rotation of the rotatable knob in a second direction causing the pin to travel in the slot in a second direction and move the slider body toward contact with a second portion of the switch to urge the switch into a second position, wherein the slider body slides along a length of the protective case.

14. The protective case of claim **13**, wherein:

the rotatable knob comprises:

a knob ring, and

a limit pin coupled the knob ring; and

the front portion of the frame defines a rotational limit slot formed therein, wherein the limit pin is positioned within the rotational limit slot and movement of the pin through the rotational limit slot limits an angular rotation of the rotatable knob.

15. The protective case of claim **14**, further comprising a locking mechanism positioned to restrict motion of the slider body in a direction transverse to a slide path of the slider body.

16. The protective case of claim **15**, wherein the locking mechanism comprises:

an elongate body spanning across a portion of the slider body;

a first locking prong coupled to a first end of the elongate body and inserted into the frame proximate to a first side of a slider groove in which the slider body is slidably disposed; and

a second locking prong coupled to a second end of the elongate body and inserted into the frame proximate to a second side of the slider groove.

17. The protective case of claim **15**, wherein the locking mechanism comprises an elongate body and a first locking prong at a first end of the elongate body and a second locking prong at a second end of the elongate body.

18. The protective case of claim **13**, wherein the front portion of the frame defines a slider groove defining a slide path and the slider body is slidably disposed within the slider groove.

19. The protective case of claim **18**, wherein the pin mechanism comprises:

a stem comprising a first end and a second end; and

a plate coupled to the second end of the stem, wherein the pin is coupled to the plate and extends therefrom and into the slot of the slider body.

20. The protective case of claim **19**, wherein the front portion of the frame wherein the frame further defines a plate-receiving groove formed within a back wall of the slider groove, wherein the plate is engaged with the plate-receiving groove and the stem extends through the frame from a first side of the frame to a second side of the frame, and wherein the first end of the stem is positioned within a pass-through opening of the rotatable knob such that the stem is non-rotatable relative to the rotatable knob.

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